may be made without departing from the essence of the invention. For example, materials other than those described in the various embodiments may be utilized for the various layers of the IBSC as long as they provide the desired characteristics achieved by the materials described in the various embodiments. Such changes are also implicitly included in the description and still fall within the scope of the present disclosure. It should be understood that this disclosure is intended to yield a patent covering numerous aspects of the invention both independently and as an overall system and in both method and apparatus modes.

Further, each of the various elements of the invention and claims may also be achieved in a variety of manners. This disclosure should be understood to encompass each such variation, be it a variation of an embodiment of any apparatus embodiment, a method or process embodiment, or even merely a variation of any element of these. Particularly, it should be understood that the words for each element of the invention may be expressed by equivalent apparatus terms or method terms. Such equivalent, broader, or even more generic terms should be considered to be encompassed in the description of each element or action. Such terms can be substituted where desired to make explicit the implicitly broad coverage to which this invention is entitled.

It should be understood that all actions may be expressed as a means for taking that action or as an element which causes that action. Similarly, each physical element disclosed should be understood to encompass a disclosure of the action which that physical element facilitates. The above is intended to cover various modifications and similar arrangements included within the spirit and scope of the below appended claims, the scope of which should be accorded the broadest interpretation so as to encompass all such modifications and similar structures and/or method steps. Therefore, the present invention includes any and all embodiments of the following below appended claims.

The invention claimed is:

1. An intermediate band solar cell comprising:

a p-n junction including a p-type layer and an n-type layer, each of the p-type and n-type layers comprising a dilute III-V nitride material including a higher conduction band and an intermediate band; and

a contact blocking layer positioned on an outer surface of the n-type layer comprising a material that provides electrical isolation of the intermediate band of the p-type and n-type layers by blocking the transport of holes and electrons in the intermediate band without blocking the transport of electrons in the higher conduction band; and

wherein the p-type and n-type layers of material comprise GaInNAs.

2. The intermediate band solar cell of claim **1**, further comprising a contact blocking layer positioned on an outer surface of the p-type layer, such that the contact blocking layers are positioned on opposing surfaces of the p-type and n-type layers to provide electrical isolation of the intermediate band of the p-type and n-type layers.

3. The intermediate band solar cell of claim **2**, wherein at least one of the contact blocking layers is lattice matched to the p-type or n-type layers.

4. The intermediate band solar cell of claim **2**, further comprising a protective layer formed on one of contact blocking layers to provide a protective covering and further provide a low resistance electrical contact.

5. The intermediate band solar cell of claim **1**, wherein the p-type and n-type layers of material comprise GaInNAs with nitrogen concentration ranging from 0.5-5%.

6. The intermediate band solar cell of claim **1**, wherein at least one of the p-type and n-type layers have a compositionally graded nitrogen concentrations to provide an electric field for more efficient charge collection.

7. The intermediate band solar cell of claim **1**, wherein a conduction band of the contact blocking layer is aligned with a corresponding higher subband of the n-type layer.

8. The intermediate band solar cell of claim **1**, wherein the contact blocking layer comprises at least one of AlGaAs and InGaP.

9. The intermediate band solar cell of claim **1**, wherein the p-type and n-type layers of the p-n junction and the contact blocking layer are formed from desired materials such that intermediate band of the p-type and n-type layers will absorb photons having energy below the band gap of the p-type and n-type layers to create an increased photocurrent when the intermediate band solar cell is exposed to solar radiation.

10. The intermediate band solar cell of claim **1**, wherein one of the p-type and n-type layers is formed on a substrate.

11. An intermediate band solar cell comprising:

a substrate;

a contact blocking layer formed on the substrate;

a p-n junction on the contact blocking layer, wherein the p-n junction includes a p-type layer of material and an n-type layer of material with each of the p-type and n-type layers of material comprising a dilute III-V nitride material including a higher conduction band and in intermediate band;

wherein the contact blocking layer is formed adjacent to at least one of the p-type layer and the n-type layer;

wherein the contact blocking layer provides electrical isolation of the intermediate band of at least one of the p-type layer and by blocking the transport of holes and electrons in the intermediate band without blocking the transport of electrons in the higher conduction band; and

wherein the p-type and n-type layers of material comprise GaInNAs.

12. The intermediate band solar cell of claim **11**, further comprising a protective layer formed on the contact blocking layer to provide a protective covering and further provide a low resistance electrical contact.

13. The intermediate band solar cell of claim **12**, wherein the contact blocking layer is lattice matched to a corresponding band gap of at least one of the p-type and n-type layers.

14. The intermediate band solar cell of claim **12**, wherein a conduction band of the contact blocking layer is aligned with a corresponding higher sub-band of at least one of the p-type and n-type layers with an intermediate band.

15. The intermediate band solar cell of claim **12**, wherein the contact blocking layer comprise at least one of AlGaAs and InGaP.

16. The intermediate band solar cell of claim **11**, wherein the p-type and n-type layers of the p-n junction and the contact blocking layer are formed from desired materials such that intermediate band of the p-type and n-type layers will absorb photons having energy below the band gap of the p-type and n-type layers to create an increased photocurrent when the intermediate band solar cell is exposed to solar radiation.

17. The intermediate band solar cell of claim **11**, wherein at least one of the p-type and n-type layers have a compositionally graded nitrogen concentrations to provide an electric field for more efficient charge collection.

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